Schedule for Fall'24

Date	Title	Resource
01.10.2024	Introduction to fuzzy logic and fuzzy sets	Fuzzy Logic with Engineering Applications (2ndEd)
08.10.2024	Introduction to fuzzy logic and fuzzy sets	Fuzzy Logic with Engineering Applications (2ndEd)
15.10.2024	Mamdani style fuzzy inference	Fuzzy Logic with Engineering Applications (2ndEd)
22.10.2024	Cascaded fuzzy Inference	A defuzzification-free hierarchical fuzzy system (DF-HFS): Rock mass rating prediction
29.10.2024	NA	
05.11.2024	Sugeno style fuzzy inference & ANFIS	ANFIS: Adaptive Neuro-Fuzzy Inference Systems
12.11.2024	Fuzzy Topsis FuzzyDematel	Web resources
19.11.2024	TPLC	https://www.fda.gov/media/122535/download?attachment
26.11.2024	NA	
03.12.2024	Performance Evaluators	Web resources
10.12.2024	Midterm assessment Group 1, No course	
17.12.2024	Midterm assessment Group 2, No course	
24.12.2024	NA	

Midterm submit via piazza is on 10.12.2024

Final submit via piazza is on when final exam is placed

Dataset has been shared on piazza (sepsis_dataset-v2.zip)

PROJECT DETAILS (For 2023-24 Fall Grading)

You will have two projects and two submission phases, one for midterm and one for final:

	Project Name	Midterm Milestone	Final Milestone
1	Development of FIS and ANFIS Models	Development of FIS and reporting what has been employed and obtained	Development of ANFIS and one more conventional ML model for the same problem when used in the midterm.
2	Enhancement of selected AutoML solution with FIS ability	Research on AutoML, selecting one of them, reporting what one is selected and enhancement design	Implementation of enhancement and presenting a video

Project 1

You have two assignments: the first one should be the Mamdani Style Fuzzy Inference System for the assessment of the midterm, and the second one is to be ANFIS and an additional data-driven method for the final exam. As a development environment, you can select Phyton, Java, or Matlab, and you must submit your source code with your Project Reports in both submissions. Importantly, do not embed your report in the source files; please prepare and submit it separately in pdf format.

You can find the sepsis data on the Piazza's resources tab. You can decide the number of instances while evaluating, but it should be in the range of (400..500) for Mamdani style FIS and (1000..1500) for ANFIS.

You have 24 hours for each sepsis and non-sepsis patient. To classify them, you can choose the first 12 or 24 hours. That zipped file contains a file named features.txt. As you can see, it has three output parameters named SIRS, qSofa, and Sepsis, along with their explanations. Please select one of them as the output and use it.

For Midterm:
You are expected to design a fuzzy rule base by yourself. Assess the correlation coefficient of the inputs and the output, which gives you a hint of what rules should be included. You may need to visualize the data to understand which instances have already been positive or negative and the min-max ranges of the inputs while they have concluded as positive or negative. As performance evaluator, a confusion matrix should be given with details of TPR, FPR, TNR, FNR, F1, and ROC(AUC)

Please note that if you get most of the output predictions as almost 0.5, you do not achieve the model; try it again with different rules. Your report should cover the topics:

1. Introduction
    a. Definition of the problem
    b. Importance of solution
    c. Suitability assessment of FIS application on the problem
2. Data
    a. Data selection approach
    b. Data distribution of the employed set
        i. correlation coefficients of the inputs and the output
        ii. correlation coefficients of each input and the resting inputs
        iii. visualization of the data distributions
    c. statistical summarization of data (min-max- std dev of parameters, number of positive and negative instances
3. Method
    a. Definition of FIS
    b. Implementation details, libraries, ready-to-use methods, and self-coded parts
    c. Rule number and fuzzy set specs etc
    d. Definition of performance evaluators
4. Results and Discussion
    a. obtained result tables
    b. Subjective interpretation on FP anf FN values and cases
    c. Suggestions for further studies

For Final:

You will create a project about ANFIS for the final exam. Additionally, you will select any other classification method to make a fair comparison and interpretation of ANFIS model. As performance evaluator, a confusion matrix should be given with details of TPR, FPR, TNR, FNR, F1, and ROC(AUC)

Please note that if you get most of the output predictions as almost 0.5, you do not achieve the model; try it again with different rules. Your report should report should have the titles:

1. Introduction
   a. Definition of the problem
   b. Importance of solution
   c. Suitability assessment of ANFIS application on the problem
2. Data
   a. Data selection approach
   b. Data distribution of the employed set
      i. correlation coefficients of the inputs and the output
      ii. correlation coefficients of each input and the resting inputs
      iii. visualization of the data distributions
   c. statistical summarization of data (min-max- std dev of parameters, number of positive and negative instances
3. Method
   a. Definition of ANFIS and other selected ML methods
   b. Implementation details, libraries, ready-to-use methods, and self-coded parts
   c. Rule number and fuzzy set specs, etc
   d. Definition of Performance Evaluators
4. Results and Discussion
   a. obtained result tables
   b. Subjective interpretation on FP and FN values and cases
   c. Suggestions for further studies

And also, conclusion and references should be placed.

Project 2

For Midterm:
Many open-access AutoML solutions are available with different input types and ML workflows. Some can be used entirely through drag-and-drop, while others require writing Python code via Jupyter Notebook. Within the scope of the project, you are requested in the first stage to explain your top three favorite AutoMLs among those you have examined, provide your reason for choosing one, and report your design on how you will extend it.
The expected content for your report should include the following information:

1. What is AutoML, and why is it necessary?
2. For the three AutoMLs examined: their source, developers, capabilities, and how an ML process is executed
3. The selected platform and extension design

Only a Mamdani-type FIS in the extension will be implemented; only triangular membership functions and the COA (Center of Area) defuzzification method will be developed, meaning an extension at the PoC (Proof of Concept) level will be made.

For Final
The implementation of the designed extension is expected. The presentation will be a usage video, and the recorded video will be uploaded via Piazza. Solving a problem with Mamdani-FIS will be recorded as an end-to-end screen capture video.